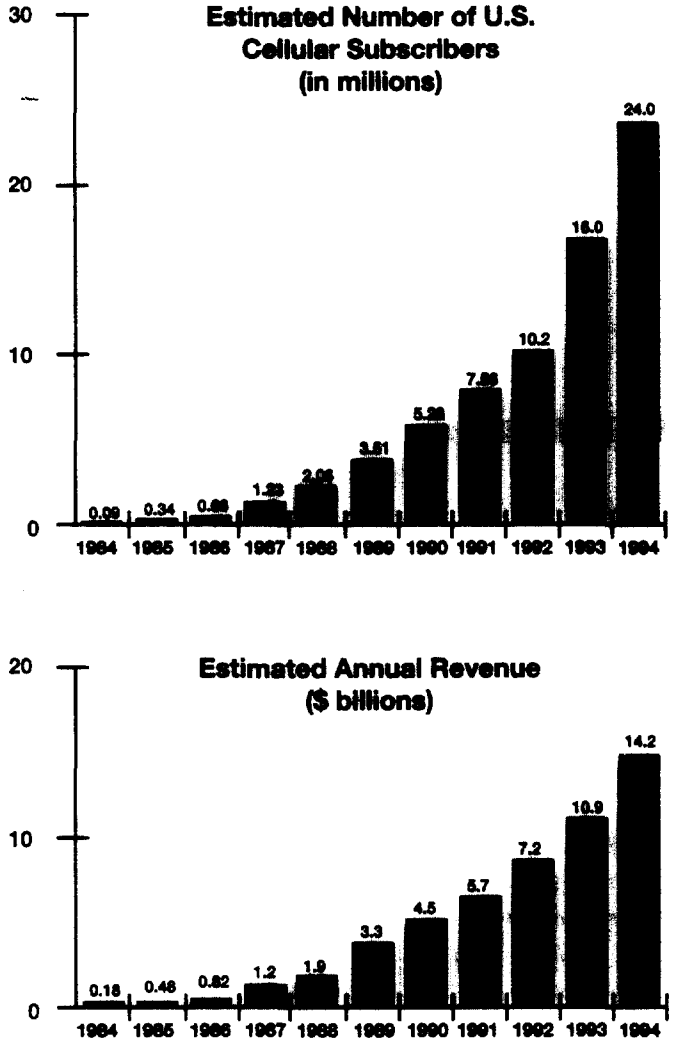
Between 1988 and 1994, the number of subscribers to cellular telephone service grew fifteenfold (from 1.6 million to 24 million) and total industry revenue grew sevenfold (from $2 billion to $14 billion). By December 1994, total subscribers had exceeded 24 million and were increasing at the rate of 5 million subscribers every six months (or about 28,000 per day).

Cellular Subscribers and Revenue



Source: Cellular Telephone Industry Association

The fact is that cellular telephony has benefited from extraordinary growth from its inception and has consistently exceeded revenue expectations. Although average revenue per subscriber per month is decreasing, the pace of subscriber growth fuels continued growth of revenue.

From its inception, the cellular telephone industry has experienced a sense of revenue adequacy. Few operators have ever expressed concern about a prospect of slowed growth in subscribers or revenue. There has long been a general

acceptance of the view that industry revenue was and would continue to be adequate to support two cellular telephone network operators.

The acceptance in the industry of revenue adequacy was strengthened by the financial performance of the network operators. Operators in diverse markets seemed to be on an inevitable progression from early operating losses to positive operating cash flow, as reflected in the chart below. Some operators have reached profitability. For example, for the years 1993 and 1994, AirTouch reported net income of $34.5 million and $98.1 million, respectively.

Selected EBITDA Information (millions)

	1986	1987	1988	1989	1990	1991	1992	1993	1994
CCI	$ (7.4)	$ (2.9)	$ 5.7	$ (2.8)	$ 39.0	$ 26.5	$ 19.3	$ 32.0	$ N/A
Centennial	-	-	-	-	(4.4)	0.7	6.7	16.9	25.2
CommNet	(0.5)	(0.8)	(0.8)	(4.7)	2.9	(6.4)	(13.7)	(3.7)	10.4
Contel	-	(1.6)	(3.9)	(1.5)	13.0	31.5	45.5	79.9	156.4
McCaw	(7.7)	60.8	(7.0)	52.1	301.3	259.1	439.3	485.4	N/A
U.S.Cellular	(4.4)	(4.7)	(5.0)	(7.8)	2.5	2.5	16.9	36.4	82.8
Vanguard	(7.7)	(9.3)	(16.9)	(21.5)	(12.2)	4.4	14.0	25.3	35.9

The adequacy of cellular telephone revenue was the product of market demand and the FCC-created duopoly. Little, if any, credit should be attributed to the industry itself for the condition of revenue adequacy. Handset subsidies surely had a positive effect upon demand, but the absence of serious competition in airtime pricing had to have had a dampening effect upon usage and, possibly, subscriber growth as well. The net effect of industry competition upon demand is difficult to assess. **The FCC's restriction of the number of competitors to two was, for its duration, the greatest gift ever bestowed upon the cellular telephone industry and the single most significant cause of the Golden Age.** The adequacy of food is, of course, relative to the number of consumers thereof. Revenue adequacy in the coming Wireless Ice Age will be severely tested in relation to the increased number of competitors.

The general sense of revenue adequacy in the Golden Age has had important effects beyond the creation of an optimistic outlook on the part of industry participants. First, it is very likely that revenue adequacy contributed to the relatively low competitive intensity in the Golden Age. Revenue adequacy meant, in practice, that obtaining a market share greater than 50% was not necessary for survival, and, indeed, having a market share where somewhat less than 50% was not a cause for financial distress. Accordingly, there was little incentive to increase market share by measures such as serious discounting of airtime pricing.

Second, subscriber growth (the driver of revenue adequacy) posed an operational problem upon the cellular telephone carriers. Dealing with the extraordinary

growth in subscribers stretched the capabilities of the operators' management support systems, sometimes to their limits. Operational effectiveness was often focused upon dealing with the very real problem of growth and thus was viewed from an essentially optimistic perspective. Operational effectiveness was often considered in the context of revenue adequacy (or abundance) as a means to deal with the stresses of prosperity not as a critical factor in the struggle for survival.

Third, the general sense of revenue growth and adequacy was very material in making capital investment available to the industry. The spiraling growth of subscribers and revenue had their inevitable effect upon lenders and investors, and the cellular telephone industry was increasingly viewed as sound.

In short, revenue adequacy has been the essential foundation of the Golden Age of Cellular Telephony, but that revenue adequacy has always been necessarily linked to the duopoly market structure which is about to be altered. **The causes of the coming Ice Age are inextricably related to changes in industry structure and their consequences.**

2.3 Skills

The importance of skills in the struggle for existence is, in a sense, directly proportional to the intensity of that struggle. Where food is inadequate, the relative hunting, gathering, and farming skills of the inhabitants of a territory will be critical as will their skills in war, the most violent form of competition.

The importance of the skills (operational effectiveness) of the cellular telephone network operators in the Golden Age was inevitably related to the competitive intensity and revenue adequacy which has characterized that period. In consequence, during the Golden Age of cellular telephony, the importance of operational effectiveness was lessened.

It is, nonetheless, useful to understand the role of operational effectiveness in the Golden Age and the consequences of the absence thereof in order to prepare for the extraordinary increase in importance that will be taken on by operational effectiveness in the coming Ice Age. Three points must be made in this regard.

First, operational effectiveness never took on the grim role of assuring survival. Revenue adequacy masked, in some degree, a wide range of operational effectiveness. What revenue adequacy created was, in effect, a broad tolerance in relation to operational effectiveness. Lesser effectiveness was not generally life-threatening.

Second, the focus of operational effectiveness was optimistically centered on the problem of growth. Handling subscriber growth was a challenge for cellular telephone operators, but it was a challenge happily faced.

Third, the broad tolerance of the cellular telephony industry for relative operational ineffectiveness was not unlimited. Nevertheless, the penalties for operating below the low end of the tolerance scale were relatively moderate. If performance resulted in financial distress, the result was not extinction or bankruptcy, but rather a buyout at price levels seemingly inconsistent with poor performance.

Metro Mobile's relatively poor operational effectiveness did not result in serious punishment being meted out to the company or its shareholders.

The company's operational ineffectiveness can best be seen in light of its indebtedness relative to its cashflow. By 1991, the company had accumulated more than $800 million of indebtedness to banks, while its operating cash flow (EBITDA) for 1991 was only $39.9 million, far less than interest charges which had reached $83.8 million, and capital expenditures which had reached $48.4 million for 1991. In 1992, Bell Atlantic paid $2.443 billion in its own stock to acquire Metro Mobile. This price was equivalent to $212/POP or about 60 times operating cash flow. As a result, the shareholders of Metro Mobile received a significant price for a company the performance of which was less, much less, than thrilling. Management shortcomings were, at worst, a misdemeanor in the Golden Age of cellular telephony.

2.4 Stores of Food

The first Initial Public Offering of a pure non-wireline cellular telephone company was Cellular Inc.'s IPO in July 1986, when the company raised $5.8 million. Vanguard Cellular Systems, Inc., which had a negative operating cash flow until 1991 and a negative EBIT until 1993, did not experience difficulties in obtaining debt and equity financing: The company's long-term debt increased from $3.6 million in 1986 to $232.2 million in 1993. Additionally, it obtained equity funding by going to the market twice. The IPO in March 1988 raised $52.8 million. In July 1991, an issuance of 3.5 million shares raised $76.43 million.

When McCaw went public in August 1987, it was already heavily leveraged, with $777.7 million in long-term obligations. The company stated that it did not expect to generate enough cash flow from operations to pay its indebtedness at maturity or to repurchase mandatory redeemable warrants issued by a subsidiary. However, McCaw was still able to raise $312 million through its Initial Public Offering.

The availability of stores of food is particularly important when the population is young and unable to produce an annual crop yield adequate to support the inhabitants.

When the cellular industry was young, its requirements for capital were substantial. Capital was needed both to build infrastructure and cover operating losses. While it is true that revenue was soon seen to be adequate, the sense of adequacy related to revenue growth and the prospect of spectacular future growth. Revenue became adequate in time to cover operating expenses, capital expenses, and interest, and more on a current basis. For several years, however, the cellular telephone industry required substantial injections of capital. Importantly, capital was available from the earliest stages of the development of the industry.

Two questions need to be answered. First, what were the sources of capital for the cellular telephone industry in the Golden Age? Second, what were the factors and analyses which made those sources willing to part with that capital? The importance of these questions is not simply historical. The fundamental underlying concern is whether capital will continue to be available through the Ice Age.

2.4.1 Sources of Capital

The wireline cellular telephone licensees had little initial difficulty in obtaining necessary capital as they were the affiliates of RBOCs and independent telephone companies which had capital themselves or had access to the necessary capital. For the RBOCs, cellular telephony was one of the first successful targets for diversification into non-regulated services following the AT&T divestiture. The wireline operators never had to struggle to secure funds at the early stages of industry development.

Capital for the non-wireline carriers in the early stages of the development of the industry was provided from more diverse sources. Certain of the non-wireline licensees were well able to provide the necessary capital (e.g., Metromedia, *The Washington Post*, etc.). Certain other non-wireline licensees had a certain degree of venture capital backing (e.g., Cellular Communications, Inc.). Certain of the licensees were partnerships of well-funded players (e.g., Metro Mobile).

Cellular Communications Inc.'s Public Financing

Between 1986 and 1989, CCI raised a significant amount of capital by going to the equity market five times in order to raise money.

Date	Number of Shares Issued	Capital Raised
July/August 1986 (IPO)	6,325,000	$28,777,000
December 1986	665,918	$7,449,000
January 1987	271,250	$3,237,000
June 1987	2,262,356	$30,867,000
May 1989	3,500,000	$119,550,000
Total		$189,900,000

Additionally, CCI issued Zero-Coupon Convertible Subordinated Notes to the public in January 1992 at a face value of $217 million. (Net proceeds to CCI were $124.9 million).

Ericsson's financing did not come about as a result of a well-thought-out strategy, but was the product of desperation. Early on, Ericsson had won the contracts to supply infrastructure to the non-wireline carriers in Buffalo, Chicago, and Detroit and seemed to be well on its way to a long string of victories when it stumbled and lost Cleveland and Miami to Northern Telecom/GE. Ericsson personnel became very concerned that the three initial victories would not provide enough base station orders to recover investment.

When the Houston non-wireline operator sent out an RFP, Ericsson advised one of the three Houston controlling partners (which was also a partner in Detroit and was, therefore, an Ericsson customer) that if Ericsson did not win the Houston bid, it would probably abandon the market, leaving Detroit in a fix. Ericsson knew that two of the Houston partners were committed to Motorola and asked the third partner what it would take to win Houston.

The third partner suggested that Ericsson offer "pay as you grow" financing and outlined an approach under which Ericsson would offer equipment financing and working capital to the operator under repayment terms which reflected the growth of subscribers on the network.

Motorola, confident of a 2 to 1 majority, did not match the Ericsson financing proposal, which was ultimately approved 3-0. "Pay as you grow" became a standard Ericsson offering and was a critical factor in Ericsson's long-term success.

Critical sources of funding on the non-wireline side in the early stages of industry development were the infrastructure vendors, particularly Ericsson. In the early 1980s, Ericsson was not an established switch or system vendor in the United States. By 1985-86, Ericsson had become a premier supplier of cellular telephone network infrastructure. The rise of Ericsson and its substantial displacement of Motorola were the result of a daring and creative financing approach. This approach was ultimately responsible for Ericsson's winning infrastructure supply contracts for the non-wireline cellular telephone systems in Houston, Los Angeles, San Francisco, Honolulu, and ultimately, for all or substantially all of the systems built by McCaw.

The critical point is that very few, if any, of the non-wireline operators (or, for that matter, wireline operators) failed to obtain the capital necessary to get into business. The Golden Age of Wireless had opened with capital availability, a central element of the early prosperity.

As the cellular telephone industry developed, greater and greater amounts of capital became available. Banks began to see cellular telephone operators as independently creditworthy, and Wall Street took a positive view of the industry and acted upon that view by underwriting large amounts of equity securities and public debt issues. The figure below lists the initial public offerings of selected carriers during the Golden Age.

Initial Public Offerings of Selected Cellular Telephone Carriers

Company	Date of IPO	Shares Issued	Proceeds To Company
Cellular Inc.	July 1986	1,200,000	$5,800,000
Cellular Communications Inc.	August 1986	6,325,000	$28,777,000
Metro Mobile	October 1986	3,450,000	$34,890,000
McCaw	August 1987	15,200,000	$311,788,000
Vanguard Cellular Systems	March 1988	5,400,000	$52,800,000
USCC	May 1988	3,450,000	$48,052,000
AirTouch	December 1993	68,500,000	$1,300,000,000

2.4.2 Factors Affecting Capital Availability

There is little mystery in answering the question why capital was attracted to the cellular telephone industry in the Golden Age. The duopoly structure and the growth and adequacy of revenues made the industry attractive. Capital became available almost independent of operational effectiveness because the impact of management upon performance was, within limits, a less significant factor than the number of competitors in each market and the very rapid growth in subscribers (and, in consequence, revenue).

The question remains, however, how tightly the availability of capital was tied to the duopoly structure which will pass with the Ice Age. The answer is very tightly. Indeed, the duopoly is an implicit, but fundamental, assumption in the generally accepted methods of valuing cellular telephone properties.

*The $/POP valuation methodology is very similar to the valuation of cable television companies on the basis of "homes passed." The number of homes passed is a meaningful indication of value only because a cable franchise is generally exclusive and its holder is, therefore, the sole beneficiary of the related revenue stream (**i.e., market share is not a consideration**).*

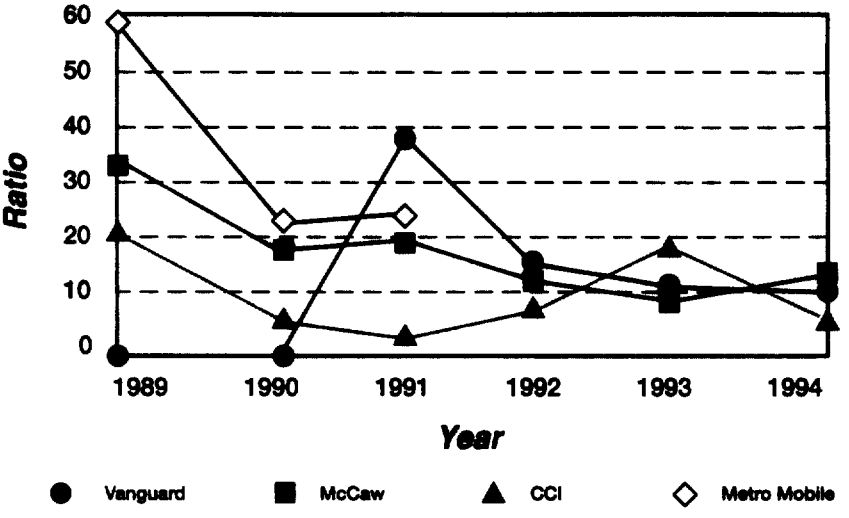
It was not until 1993/1994 that companies such as Vanguard Cellular Systems, McCaw Cellular Communications, Inc., and CommNet were able to cover their net interest expenses with operating cash flows. Additionally, even when interest coverage did become positive, several cellular companies maintained fairly high total debt to cash flow multiples.

Nextel's desire to position itself as the third cellular carrier is made evident in its annual reports. Since the company first went public as Fleet Call, it has been positioning itself to be measured in $/POP.
The 1992 annual report states, "Fleet Call's markets include 61.1 million people, or 'POPs' in cellular industry terminology."
The 1993 annual report states, "Our merger with DisCom and our pending acquisition of a majority interest in AMS will make us, in the words of a leading industry observer, 'the nation's new #1 in wireless POPs."
Nextel's effort to position itself

The concept of $/POP is built upon the assumption of duopoly. The entire notion that a cellular license has value related to the population served is constructed upon the basis that there are only two competitors and that those competitors will share the market more or less equally. The regulatory bar to new competitors and its consequence that the two incumbents would share the entire cellular telephone revenue stream themselves are at the heart of the $/POP valuation methodology. It is also clear that the $/POP valuation methodology is unrelated to operational effectiveness.

Cellular valuation methodologies were important not only in transactions involving the purchase of cellular telephone interests, but also in the extension of credit to the industry. Telecommunications industry lenders have generally looked to cash flow as their source of repayment. In the cellular telephony industry, however, credit became available before cash flow was adequate to assure repayment of indebtedness. This inadequacy is reflected in the chart below. Banks and other lenders had to be relying in significant degree upon the value of the properties in $/POP as a secondary source of repayment.

Ratio of Long-Term Debt to EBITDA



In summary, the assumption of duopoly is, quite naturally, imbedded in the cellular telephone valuation methodologies used in the Golden Age, *but the underlying assumptions will not hold in the Ice Age.*

The Golden Age has provided at least one example of how differently a mobile telephone company would be valued without the assumption of duopoly. Nextel, an ESMR provider, clearly saw the advantage of being viewed similarly to cellular telephone companies for the purpose of valuation. Nextel sought to latch onto the $/POP valuation approach and to be viewed as a third cellular carrier. For quite some time, it appeared that Nextel's efforts in this respect would, in fact, take hold. Nextel raised very large sums of money from highly respectable sources.

as the third cellular carrier paid off spectacularly in terms of securing capital. At the beginning of 1991, Nextel (then Fleet Call) was primarily debt financed. One year later over $112 million was raised in an IPO. At the same time, Matsushita agreed to a $45 million equity investment. The proceeds of these two share issuances were used to pay off long-term debt. By March of 1991 Nextel had virtually no long-term debt and access to $300 million in vendor financing from Motorola and Northern Telecom.

In June of 1992, Comcast committed to an equity investment of up to $100 million. Later, in February of 1993, Comcast agreed to increase its equity commitment by another $115 million.

From April 1993 to March 1994, the amount of capital available to Nextel took a quantum leap. The company raised over $1 billion through two public debt offerings, secured another $114 million in equity investment from Comcast, obtained $75 million equity investment from NTT, and reached an agreement in principle with MCI to invest up to $1.4 billion.

Although the MCI deal was not ultimately made, during 1994, Nextel was able to trade 62 million shares for 2,500 SMR licenses held by Motorola, a deal which gave Motorola over 24% ownership in Nextel. As part of that transaction, Motorola's credit line was extended such that the amount of Motorola/NT financing available to Nextel was $650 million by the end of 1994.

Largely as a result of MCI's withdrawal, Nextel's stock price dropped from a high of $46.25 in March, 1994 to below $10 in early 1995, resulting in an estimated loss of $2.5 billion in market value.

Nextel has since backed away from any claims to be the third cellular carrier, instead repositioning itself to be the premier provider of advanced dispatch services and other communications services targeted to mobile work groups. This repositioning, however, has not inhibited Nextel's drawing power, as evidenced by Craig McCaw's recent annoucement of his intention to invest up to $1.1 billion in Nextel over the next few years.

The $/POP valuation methodology carries with it certain expectations based upon the duopoly market structure and revenue adequacy. Nextel's ability to attain and sustain anything like a $/POP valuation depended upon meeting the expectations of the financial markets in relation to subscriber growth. This task was one that Nextel was unable to fulfill, and the price of its stock fell precipitously. In a sense, Nextel was experiencing Ice Age effects before the Ice Age arrived. The Nextel experience sheds light on the effect of changes in the fundamental forces of population (number and nature of competitors) and crop yield (annual revenues) which should not be lost upon any concerned observer of the closing stages of the Golden Age.

2.5 Last Word on Cellular Telephony in the Golden Age

Of the four fundamental forces that shaped cellular telephony in the Golden Age, two emerged as dominant: population and crop yield. The small competitive population resulting from the duopoly established by the FCC and generally accepted sense of revenue adequacy and even abundance created, in very substantial measure, the Golden Age. In the coming Wireless Ice Age, the forces and their balance will be fundamentally altered:

- **The duopoly will give way to multiple competitors;**
- **The adequacy of revenue in relation to those multiple competitors is, at the very least, highly doubtful;**
- **Operational effectiveness will become, as it was not before, a condition of survival; and**
- **Capital availability will become more restricted and will not be determined so much on an industry-wide basis as on the basis of actual company performance.**

These changes will close the Golden Age of mobile telephony and, in their aggregate effect, commence the Wireless Ice Age.

It is a fundamental premise of this monograph that those who truly understand the Golden Age of Wireless will be in the best position to understand the coming Ice Age.

> *"It is not possible to be ignorant of the end of things if we know their beginning."*
>
> **St. Thomas Aquinas *(1225-74)***

Short-Lived Lessons From the Past

"The past is a foreign country: they do things differently there."

L.P. Hartley
The Go Between (1953)

"What happened to the early apes? We know that the climate began to work against them and that... their forest strongholds had become seriously reduced in size. The ancestral apes were forced to do one of two things: either they had to cling on to what was left of their old forest homes, or, in an almost biblical sense, they had to face expulsion from the Garden. The ancestors of the chimpanzees, gorillas, gibbons and orangs stayed put, and their numbers have been slowly dwindling ever since. The ancestors of the... naked ape... left the forests, and threw themselves into competition with the already efficiently adapted ground-dwellers. It was risky business, but in terms of evolutionary success it paid dividends."

Desmond Morris
The Naked Ape (1967)

"Science must begin with myths, and with criticism of myths."

Sir Karl Popper
(1902-1994)

3.0 The Past as a Source of Information

Inhabitants of the Golden Age drew several lessons from their experience in the wireless world. Those lessons reflected experience formed by the fundamental forces (inhabitants, crop yield, skills, and stores of food) as in effect at the time. Those lessons, valid in the Golden Age, could be followed in that period with likely success. The validity of these lessons may not, however, extend to the coming Wireless Ice Age when competitors, revenue, operational effectiveness, and capital availability will change drastically. Inhabitants of the wireless world must re-examine the lessons of the Golden Age and reject many of them as no longer useful guidelines and, possibly, even dangerous ones.

This chapter will consider four lessons drawn from the experience of the Golden Age – one for each of the four fundamental forces – and question their validity in the Ice Age.

"False facts are highly injurous to the progress of science, for they often endure long; but false views, if supported by some evidence, do little harm, for everyone takes a salutary pleasure in proving their falseness; and when this is done, one path towards error is closed and the road to truth at the same time opens."

Charles Darwin
The Decent of Man (1871)

"It's not just when we inherit from our mothers and fathers that haunts us. It's all kinds of old defunct theories, all sorts of old defunct beliefs, and things like that. It's not that they actually live on in us; they are simply lodged there, and we cannot get rid of them."

Henrik Ibsen
(1828-1906)

3.1 Lesson Concerning the Population

"We know how to compete because we've been doing it for years."

Wireless carriers face new competition from PCS licensees in the near future. The incumbents have relied upon their experience in competing in the Golden Age to conclude that they are ready for the increased number of competitors and the nature of the competition to come. An officer of a prominent wireline cellular telephone operator recently stated that "cellular carriers are already battle-hardened because we've competed for 10 years... Anyone who comes in to start up a new wireless service will have to deal with a competitor who has a 10 year head start." That incumbents have considerable advantages against new competitors cannot be denied, but is the experience of the incumbents in competing during the Golden Age one of those advantages? The answer to that question must be far less resoundingly affirmative than would make the incumbents comfortable. The nature and intensity of competition in the Golden Age depended very much on market structure, and the experience of cellular telephone operators may not have prepared them for the rigors of competition in the Ice Age.

New lessons concerning competition and marketing will be required to provide useful guidance for Ice Age survival. Reliance upon Golden Age strategies and thinking could turn an operator into an endangered species.

3.2 Lesson Concerning the Food Supply

"If you build it, they will come (always in adequate numbers)."

This lesson is implicit in the actions of the many bidders for PCS spectrum to offer large sums for licenses to build new networks which will not benefit from the market structure of the Golden Age. Still, the general sense of revenue adequacy of the Golden Age and the spectacular growth of wireless subscribers during that period surely underlie the belief that wireless networks need only be built to attract subscribers.

The proliferation of networks as a result of the licensing of numerous PCS carriers will certainly test that belief. Revenue adequacy is always relative to the number of networks to be supported, and, unless the advent of more competition causes a very material increase in demand, substantially the same revenue will have to support several more carriers.

The assumption of revenue adequacy cannot withstand the realities of Ice Age population growth.

3.3 Lesson Concerning Skills

"Operational effectiveness affects profitability, not survival."

It is the fact that, during the Golden Age of cellular telephony, operational effectiveness was not viewed as a matter with implications for survival. Operational

effectiveness may have affected relative profitability, but was unnecessary to avoid extinction.

The limited importance of operational effectiveness is, however, a conclusion strictly related to the conditions of the Golden Age. When the market structure of that period gives way to that of the Ice Age and when the adequacy of revenue is measured against the increased number of competitors, operational effectiveness will be a condition to survival.

Operational effectiveness will become critical in obtaining a disproportionate share of inadequate revenue and in achieving the lowest possible costs so as to make the available revenue extend as far as possible.

Approaching the Ice Age without the critical tools and survival skills will be a formula for extinction.

3.4 Lesson Concerning Stores of Food

"Ownership of radio spectrum is an assurance of wealth."

During the Golden Age of Wireless, a radio license was considered, and often properly so, as a sufficient condition for the creation of riches. The theory was (and for some still is) that as a radio spectrum, like beachfront property, is a scarce resource, and no more is being made. As one intended PCS investor recently remarked, "spectrum is a finite resource, and is therefore likely to appreciate rapidly."[4] This perspective, which is rooted in the Golden Age, confuses the scarcity of spectrum with scarcity of FCC mobile telephone spectrum allocations at that time and ignores the effect of improvements in capacity due to technological advances.

Cellular telephone licenses were very valuable in the Golden Age not because God did not make adequate radio spectrum, but, rather, because the FCC allowed for only two operators. That situation has now changed as the FCC has authorized as many as six PCS network providers and allocated substantial additional spectrum (120 MHz).

Additionally, new modulation schemes have increased the effective capacity of finite amounts of spectrum, and, while technology cannot make more spectrum, it can make more spectrum useable (e.g., at increasingly higher frequencies) and make spectrum utilization more efficient.

Accordingly, spectrum is a necessary, but not sufficient, condition for the creation of wealth in wireless network operations. The persistence of belief to the contrary is quite surprising in that by no means all wireless operators became wealthy during the Golden Age. Telepoint operators in the U.K. suffered substantial losses, and such systems were ultimately abandoned. The spectrum allocations by the Department of Trade and Industry to British Telecom, Hutchinson, etc. were hardly assurances of wealth. In fact, public reports suggest that Hutchinson may have lost more that $180 million on its Rabbit telepoint network.

[4] *Computer Letter, January 23, 1995*

3.5 Last Word on Golden Age Mythology

The persistence of belief in lessons drawn from a past so obviously different from the expected future is disastrously akin to belief in superstitions and mythology. If such beliefs were harmless, they would not merit review, but, in fact, such beliefs obscure the future and can cause the deferral of necessary preparation for the harsh conditions of the Ice Age. The misread lessons of the past are no more effective tools for the Ice Age than rabbits' feet or four-leaf clovers. Time has a corrosive effect on past learning, and it is, therefore, dangerous to walk into the future looking backward.

> *"The Creation is never over. It had a beginning but it has no ending. Creation is always busy making new scenes, new things, and new Worlds."*
>
> **Immanuel Kant**
> ***A General Natural History and Theory of the Heavens, 1755***

The Challenges of the Ice Age

"We will now discuss in a little more detail the struggle for existence."

Charles Darwin
On the Origin of Species, 1859

"All that we can do, is to keep steadily in mind that each organic being is striving to increase at a geometrical ratio; that each at some period of its life, during some season of the year, during each generation or at intervals, has to struggle for life, and to suffer great destruction. When we reflect on this struggle, we may console ourselves with the full belief, that the war of nature is not incessant, that no fear is felt, that death is generally prompt, and that the vigorous, the healthy, and the happy survive and multiply."

Charles Darwin
On the Origin of Species, 1859

"Is it not the height of silent humour to cause an unknown change in the earth's climate."

Robert Graves
(1895-1985)

4.0 Introduction

The Wireless Ice Age is coming as a result of changes to the four fundamental forces which shape the wireless world. *First, the population will increase substantially.* The new inhabitants of the wireless world will arrive as a result of the licensing of PCS providers. The cozy duopoly of the Golden Age will come to an end. The end of the duopoly will be reflected in a material increase in the intensity of competition.

***Second, food will become relatively scarce.* The general sense so evident in the Golden Age that revenue was adequate to the needs of the population will no longer prevail. Although industry subscriber levels and industry revenue will increase, they will not be adequate to support the increases in population. The inadequacy of revenue relative to the number of competitors will be exacerbated by the decline in the average revenue per subscriber which will be caused by a combination of (i) price competition and (ii) pricing practices designed to stimulate**

subscriber demand. Moreover, in time, subscriber and revenue growth for the industry will decline as the market approaches saturation.

Third, skills will become critical to survival. **Marketing skills will be essential to secure the disproportional market share needed to survive. Operations skills will be required to contain costs in a revenue-constrained environment, to contend with the increased complexity of the operating environment, and to meet customers' requirements for service in the buyers' market created by intense competition.**

Fourth, the stores of food available to the population of the wireless world will shrink. **The capital availability in the Golden Age was a product of the duopoly structure of the market and the adequacy of revenue. Those conditions will not continue into the Ice Age. However, it is not clear that capital availability will be constrained early enough to prevent the emergence of all possible competitors. Subsequent capital constraints could induce competitors to take drastic actions which will likely contribute to the intensity of competition.**

These changes will have extremely serious consequences for the inhabitants of the Wireless Ice Age. The fundamental question will be whether all the inhabitants can be supported by the available food and the stores thereof. In many, if not all, markets, fewer providers than licensees can continue to exist in the long term.

This is the central message of the Ice Age: *Unlike the Golden Age, in which survivability and value creation were not in question, a number (perhaps many) of the inhabitants of the Wireless Ice Age will starve to death.*

4.1 Population

"When all the world is overcharged with inhabitants, then the last remedy of all is war..."

Thomas Hobbes
(1588-1679)

The industry structure in the Golden Age tended to lessen the intensity of competition. The duopoly and the nature of the inhabitants combined to restrain or moderate the intensity of competition, particularly in relation to air-time pricing.

As the wireless industry changes, the duopoly disappears, and the concentration of the industry is reversed by the addition of new inhabitants, drivers of competitive intensity, which were suppressed and defused in the Golden Age, will emerge with strength and clarity in the coming Ice Age. Certain of these drivers are identified in the figure below.

Drivers of Competitive Intensity

Driver of Competitive Intensity	Conditions When Competitive Intensity is Increased
Number and type of competitors	• Resale permitted • Entrance of new competitors with deep pockets • Absence of dominant competitor • Entrance of competitors with vertical and/or horizontal business interests
Overall market demand	• Saturated or saturating market • Demand only at lower prices
Customer churn	• Low switching costs for customers • Low exit barriers for customers
Cost structure of network operator	• High exit barriers (large initial investment) • Low marginal operating costs
Capital structure of network operator	• Pressure for return on capital • Ability to tolerate low returns
Product differentiation	• Few suppliers = limited differentiation • Pursuit of the same market segments by all players

4.1.1 Number and Nature of Competitors

New entrants will join the cellular telephone duopoly in offering mobile telephony services. The new entrants will come from two sources although the nature of the new entrants will be more diverse than their license origins. The PCS auctions will provide most of the new licensees, but they will be supplemented by ESMRS providers (although not likely more than one in a market).

The PCS auctions could, in principle, provide as many as six new operators in each territory, but that result is not likely. The FCC will auction a total of six blocks of frequencies (Blocks A through F) based upon two different geographic bases and two different amounts of spectrum. (The auction of Blocks A and B was completed in March 1995.) It seems likely that between three and five independent PCS operators will join the two cellular carriers in each service territory and that the total number of facilities-based competitors could rise from two to between four and seven (two cellular, four PCS, one ESMRS). That total does not include resellers.

The shift from duopoly to competition among as many as seven operators will itself increase the intensity of competition, but the nature of the new competitors will be an equally important source of competitive intensity.

In practice, the competitive activities of the cellular carriers in the Golden Age were largely benign. The duopoly restrained competitive intensity, and the cellular telephone technology did not lend itself to use as a substitute for wired telephony. The cellular telephony duopoly was content in the Golden Age with serving truly mobile customers which were in that period available in sufficient numbers.

The agendas of most, if not all, the new PCS licensees would not, in any sense, appear to be benign from a competitive standpoint. There are a number of reasons for this new competitive aggressiveness (even from former duopolists), which are summarized in the figure below.

Reasons For New Competitive Aggressiveness

1) **Need to attack incumbents**
2) **Inevitable airtime price competition**
3) **Landline substitution strategy**
4) **Strategies of IXCs**
5) **Effect of convergence**
6) **The possibility of an unpredictable competitor**
7) **The possibility of a disappointed competitor**
8) **The effect of resale**
9) **Competition from narrowband PCS**

First, every new entrant faces two incumbents with all the market share before the new competition begins. The new entrants have two sources of customers – customers new to mobile telephony and the customers of the incumbents. The two incumbents have been used to sharing 100% of the spectacular growth in

customers and will not easily cede a share in that growth to newcomers. New entrants may or may not plan initially to seek to draw customers from the incumbents. However, unless the new mobile customers garnered by the PCS operators are sufficient to meet their expectations, they will, in due course, be forced to raid the incumbents' customer base, and the incumbents will certainly resist. **The mere fact of new market entrants must materially increase competitive intensity as the new entrants seek to secure market share.**

"The rich experience of history teaches that up to now, not a single class has voluntarily made way for another class."

Joseph Stalin
(1879-1953)

Second, in the process of new entrants' seeking to garner market share, airtime price competition, so moderate in intensity during in the Golden Age, will be an element of each new competitor's strategy from the beginning or will soon become an element as that competitor's service offering fails to attract adequate subscriber revenue. **The inevitability of airtime price competition is a critical source of increased competitive intensity.**

Third, PCS technologies may lend themselves to use as platforms for substitution of wireline telephones. High capacity digital PCS networks offer the possibility of competing not merely for mobile customers, but also for customers of basic landline telephone service. That possibility will add a new dimension to the competitive matrix. Any attempt at landline substitution must necessarily involve pricing which is very aggressive when compared to the duopoly rates of the Golden Age. Wireless telephony has always commanded a significant premium over basic local telephone service. If wireless operators are to secure any material share of the local landline telephone market, pricing for wireless service will have to be orders of magnitude less expensive than current cellular telephone rates when measured in terms of both access pricing and included minutes. **Aggressive pricing, for the purpose of landline substitution, must have some significant spillover effect on general mobile service pricing and will, in consequence, generally increase competitive intensity.**

"To the old, the new is usually bad news"

Eric Hoffer
(1902-1983)

Fourth, those PCS licensees which are interexchange carriers (IXCs), AT&T in particular, see wireless as a means of obtaining access to local phone users without the payment of access charges to the LECs for the origination and termination of long distance calls. How the savings in access charges will be considered by IXCs which are wireless network providers is unclear, but those savings, which are in whole or in part not available to wireless network providers which are not facilities-based IXCs, may materially and favorably change the financial results of the IXCs as wireless carriers and permit more aggressive airtime pricing than would otherwise be the case. **Thus, the entry of IXCs into the wireless telephony market may result in particularly aggressive pricing, and the effect of such pricing upon competitive intensity is self-evident.**

Fifth, the effect of a separate agenda upon wireless pricing is not limited to the instance of IXCs and access charge avoidance. Indeed, that instance is simply a special case representative of a broader problem. As telecommunications technologies converge and regulatory barriers are removed, previously distinct revenue streams (telephony, wireless telephony, cable television, and long distance) become

increasingly subject to competition. For major telecommunications operators, wireless telephony is just another telecom service offering which may be useful to capture customers and will be combined with other offerings to present a comprehensive array of services. **Wireless telephony in the Ice Age will, therefore, experience an increased competitive intensity as convergence generally raises the stakes in telecommunications.**

"Things fall apart; the center cannot hold; mere anarchy is loosed upon the world; the blood-dimmed tide is loosed, and everywhere the ceremony of innocence is drowned, the best lack all conviction, while the worst are full of passionate intensity."

William Butler Yeats
(1865 - 1939)
The Second Coming

Sixth, at least some of the PCS licensees will not be experienced wireless providers or have links to such providers. Such inexperience may lead to wide-ranging experimentation in the approach to marketing. Lack of success could magnify such experimentation. **An unpredictable competitor could increase competitive intensity as carriers seek to respond to a pattern of activity that does not meet their expectations.**

Seventh, certain wireless providers, like Nextel, have already disappointed the marketplace and have paid a price in terms of share values, but Nextel is not without resources, and an aggressive program to reassert Nextel's claim to serious consideration in mobile telephony could be an early trigger for the commencement of price competition. **Indeed, any wireless carrier which has disappointed itself or the capital markets could increase competitive intensity by pricing to capture market share, and the opportunities for disappointment will be widely-available in the coming Ice Age.**

"One can relish the varied idiocy of human action during a panic to the full, for, while it is a time of great tragedy, nothing is being lost but money."

John Kenneth Galbraith
The Great Crash, 1929 (1955)

Eighth, facilities-based carriers will not be the only source of increased competition attributable to industry structure. Significant potential resellers (e.g., MCI and Time-Warner) are emerging with plans to bundle wireless services with other offerings. Those bundling efforts are designed to obtain competitive advantage in one or more markets and will have the effect of increasing overall competitive intensity in the wireless industry by importing the competitive intensity of those other markets (e.g., long distance) and by adding recognized brand names to the competitive mix in the wireless industry. Moreover, facilities-based carriers which are experiencing disappointment may turn to resellers for assistance in loading their networks and offer substantial margins to the resellers. The resellers may, for competitive reasons extrinsic to the wireless market, price the resold wireless service very aggressively (e.g., to attract customers for other services). Having no infrastructure investment, the resellers are in a position to exercise significant price flexibility. **Resellers, if they choose to do so, could contribute significantly to the increase in competitive industry.**

Ninth, facilities-based carriers from other segments of the wireless industry could contribute significantly to the competitive intensity of the wireless telephony segment. In the Golden Age, the cellular telephone and paging industries coexisted peacefully with little inter-segment competition. Paging as a one-way signaling technology had a growing market, but one which exhibited little substitution capability in relation to the two-way service of cellular telephony. The FCC has auctioned the narrowband PCS spectrum to provide for various forms of advanced paging, including two-way paging, which could be in the form of

voice or data. Voice messaging with response may become a low end competitor to mobile telephony, including broadband PCS, and, if priced aggressively, could either capture a share of consumer demand for mobile communications or force the providers of mobile telephony to the increase in competitive intensity in mobile telephony. **The end of the cellular telephone duopoly would itself increase competitive intensity, but the number of competitors will not alone explain the changed nature of competitive behavior. The agendas, strengths, and weakness of the new entrants will also contribute to the intensification of competition.**

"No testimony is sufficient to establish a miracle unless... its falsehood would be more miraculous than the fact it endeavors to establish."

David Hume
(1711-1776)

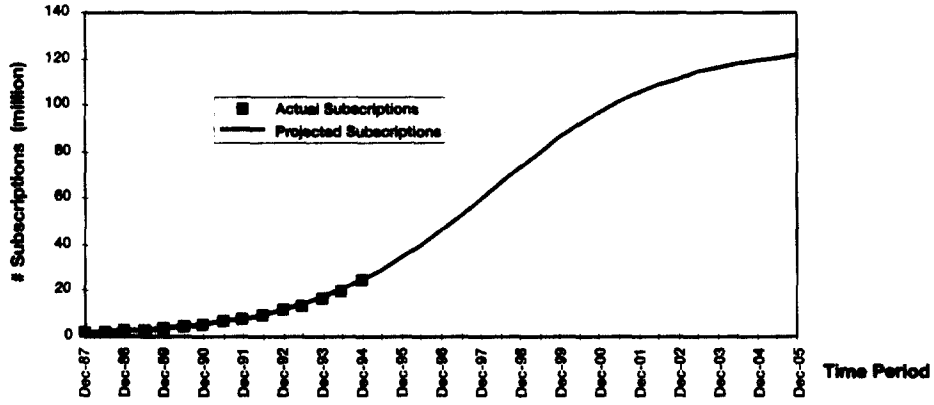
4.1.2 Growth of Overall Market Demand

In the Golden Age of cellular telephony, revenue adequacy and the duopoly then in effect combined to moderate the intensity of competition. Subscriber growth was spectacular relative to the number of players and made vigorous competition unnecessary because a disproportionate share of the market was not essential to survival.

If subscriber growth (and its consequences in terms of revenue) is sufficient to satisfy the needs of all carriers, subscriber growth will not necessarily be a source of increased competitive intensity. If, however, subscriber growth is inadequate for the increased number of competitors, and competitors, especially new entrants, require disproportionate market shares to survive, then the inadequacy of subscribers (and, hence, revenue) will drive competitive intensity.

The Ice Age is unavoidable absent unending subscriber growth at a high rate. The problem is that subscriber growth will slow down even under the most optimistic projections of penetration. Uncritical wireless enthusiasts have expressed in private their belief in the miracle of unending rapid subscriber growth, but that belief is unsupportable. The demand curve (plotting subscribers against time) will likely take the characteristic shape indicated in the figure below, which follows historical penetration and the standard adoption S-curve of technological products and services. The projection of 120 million mobile telephony subscribers in the year 2005, reflected in the figure below, is consistent with the recent estimate of the Personal Communications Industry Association.

Eventual Saturation of the Wireless Voice Market



Source: Actual subscription data from CTIA. Projected subscription data are EDS research based on PCIA projections.

The derived penetration curve has several interesting characteristics. First, the inflection point (the date after which the absolute number of new subscribers added in any period is less than the previous period) will occur in 1998. This characteristic indicates that from 1999 onward, absolute subscriber growth will decline, and competitors will no longer be able to rely in the same degree as in the past upon market growth as a source of increased revenue.

Accordingly, in the not too distant future, competitors will have to start to look to sources of subscribers other than market growth. The remaining source is the existing subscriber base of other competitors. The process of tapping that source necessarily involves a concomitant increase in competitive intensity.

Second, the cusp of the curve occurs around 2002. At that point, the rate of industry subscriber growth falls off dramatically. As the market approaches saturation, providers will become increasingly hard-pressed to replace customers who churn out of the system. **The effect of churn near the time of market saturation is to remit competitors to tactics designed to take customers away from others, thereby intensifying competitive pressures.**

Third, although the penetration curve indicates that the absolute number of new subscribers will continue to grow rapidly for several years hence, on a percentage basis, industry growth is slowing much quicker than it appears. The figure below translates the penetration curve into a year-on-year industry subscriber growth rate and shows the corresponding industry revenue growth rate assuming a constant ten percent per year nominal decline in average revenue per subscriber for all years 1997 through 2001.

Subscriber and Revenue Growth Rates

During the Year	Subscriber Growth Rate	Industry Revenue Growth Rate
1993 (Actual)	43%	37%
1997 (Est.)	29%	18%
2001 (Est.)	10%	0%

Source: EDS research

The decline in airtime pricing is an expression of competitive intensity. If competitive intensity increases more quickly than the 10 percent annual decline used to calculate the data in the figure above, then industry revenue growth could end well before the year 2001. **Thus, if competitive intensity is sustained over the long term, industry revenues could actually decline as the effect of decreasing average revenue per subscriber will be greater than the effect of subscriber growth.**

4.1.3 Customer Churn

Churn has been a persistent issue for the cellular telephone industry. With churn rates at about 2.5 percent per month, operators must replace the equivalent of half of their entire customer base every 20 months just to maintain their positions.

Churn will become critical in the Ice Age as the market becomes saturated. Market growth will no longer be an effective source of replacement subscribers, and, absent sufficient replacement subscribers, a competitor's market share will shrink. **Shrinkage in a competitor's customer base as a result of unreplaced churned customers will likely cause the competitor to try to reverse the trend by resorting to intensified competitive actions, including lowering prices.**

4.1.4 Differing Cost Structures

The competitors in the duopoly of the Golden Age had substantially similar cost structures in terms of both fixed and marginal costs. Cellular telephone systems were essentially similar in design and implementation, and, since the importance of operational effectiveness was minimized, fixed costs and operating costs did not diverge materially. Accordingly, there was no possibility of a materially lower cost structure which would provide competitive advantage. Cost structure differentials did not, therefore, contribute to competitive intensity.

In the Ice Age, cost variability, both fixed and marginal, will be much greater. Such cost variability is the result of a number of factors.

First, the **different technologies** open to adoption by PCS licensees, in the absence of a standard imposed by the FCC, have differing cost structures, and those cost structures are quite different from that of cellular telephone operators.

Second, **resellers** are likely to play a significant role in the Wireless Ice Age, a role far more important than that which they played in the Golden Age. Reseller cost structures are obviously very different from those of facilities-based carriers.

Third, **recent partnership arrangements** will add to competitive intensity. Partnership arrangements in cellular telephony of the Golden Age arose generally as a result of settlements between contenders of licenses. The recent partnerships formed to develop PCS networks were formed for the purpose of creating competitive advantage (e.g., access to customers, access to infrastructure, etc.). Those partnerships will magnify differences in the cost structure of the competitors.

Fourth, **bundling of communications services** will increase competitive intensity. Cellular telephone service in the Golden Age was not generally bundled with other services. Mobile telephone service in the Ice Age will be one of the converging technologies which certain providers will seek to bundle with diverse other services (wired telephony, entertainment, long distance service, and, possibly, even electric power). The bundling of services will create marketing costs very different from unbundled services, and the pricing of bundled services may be very different from the pricing of the disaggregated components.

Differences in cost structure can provide certain operators with more flexibility than others in terms of pricing. Operators will likely avail themselves of that flexibility in the event they experience disappointment in subscriber and revenue growth. Thus, cost structure differentials could contribute to the increase in competitive intensity in the Ice Age.

4.1.5 Providers of Capital

In the Golden Age of cellular telephony, providers of capital were generally patient because values were increasing. The general patience of the capital markets (and private sources of capital) meant that operators dependent upon such capital sources did not have to adjust their approaches to the market, i.e., become more competitively aggressive to meet the expectations of those capital sources.

In the Wireless Ice Age, those who have provided capital to network operators will demonstrate much greater sensitivity to the results of the operations of the providers of mobile telephone service in which they have invested. Those responses will contribute to the increase in competitive intensity.

Certainly, some providers of capital will show considerable patience because they have taken a very long-term view of market development. This patience could be particularly evident in the corporate parents of the major wireless operators, especially when their wireless agenda is an element of a broader integrated strategy (e.g., AT&T, Sprint and its partners in Wireless Co.). The patience of such capital providers will facilitate aggressive pricing to achieve long-term market share and will thus contribute to increased competitive intensity.

However, most providers of capital will show considerable impatience because their expectations will soon be seen to be unfulfilled. Some of such providers of capital will have relied upon the short-lived lessons of the Golden Age and will be disappointed early in the Ice Age. The expression of their impatience to their investees (and their likely threat to withhold additional capital) will likely cause actions to be taken to increase subscriber growth and market share. These actions, whether effective, will serve to increase competitive intensity.

4.1.6 Conclusions Concerning Population

All drivers of competitive intensity will be aligned in the Ice Age toward increasing, not decreasing, the level of competitive intensity. The cumulative effect of those drivers will be a ferociously competitive marketplace.

Although the impulse toward price competition will affect some carriers more than others, certain drivers (e.g., ultimate market saturation and churn) will impel all carriers toward price competition either in response to their own disappointment or in reaction to the responses of others to their disappointment. Isolation from the effects of price competition is not possible.

4.2 Food Supply

Fundamental to the Ice Age is the inadequacy of revenue to support all of the population. The drivers of competitive intensity which derive from the population and the nature of competition will be fueled by revenue inadequacy relative to the population.

Revenue inadequacy and competitive intensity are closely inter-related. Revenue inadequacy is, in a sense, the cause of the actions taken to increase market

share (and hence greater revenue). Those actions, which often involve aggressive pricing, increase competitive intensity, but may also deepen revenue inadequacy if the price decreases do not increase subscriber revenue sufficiently to offset lower price levels.

The conclusion of ultimate revenue inadequacy in the Ice Age depends upon the level to which service pricing will fall as a result of competition and the revenue requirements of the several carriers.

4.2.1 Decrease in Average Revenues per Subscriber

Average Revenue Per Subscriber (ARPS) has been decreasing at the rate of 8 percent per year, measured in nominal terms, since 1987. These price declines have been primarily related to lower-usage subscribers coming onto network, as opposed to price competition between the cellular carriers. Indeed, the CTIA recently estimated that ARPS for new subscribers have been averaging about $40 per month, even though the overall customer base has been averaging $58.65 per month. Most industry analysts agree that lower-usage customers will continue to be the primary source of subscriber growth.

Aggressive price competition will begin in late 1996 or early 1997 as PCS providers turn on their networks. The ultimate price floor is very difficult to estimate. However, if ARPS is currently decreasing at the rate of 8 percent per year, then decreases of 10 percent per year from 1997 onward would seem reasonably conservative. Upon this basis, ARPS (net of long distance revenues) would decrease to $30-$35 per month by the year 2000 and continue decreasing to $20 per month by the year 2005.

While some may argue that ARPS (net of long distance revenues) may stabilize somewhere between $25 and $40 per month by 2005, subsequent sections will explore how revenue inadequacy for the industry will lead some players to conduct price wars in their attempts to prevent being forced from the market.

4.2.2 Effect of Revenue Inadequacy on New PCS Operators

The proprietary model used to predict the market share required by a single MTA PCS provider to survive can serve as a competitive analysis/prediction tool. The model can be used on behalf of a particular wireless provider to predict the financial distress and potential resulting actions of its competitors. This understanding could be critical in helping a company prepare for and be proactive to a competitor's actions in the Ice Age.

In order to explore the conditions under which revenue inadequacy will occur, a high-level financial model was constructed to simulate the future mobile telephone industry. This proprietary model, based on what are believed to be reasonably conservative assumptions, was designed to calculate the market share required by a single MTA PCS provider to survive.

The primary assumptions used by the model are as follows:

- The growth of PCS services will follow a second-generation adoption model. The adoption curve is calculated using standard Bass diffusion techniques.
- The overall wireless telephony market will reach 40 percent population penetration by year 2006, of which PCS will account for 15 percent. Existing cellular telephony and ESMRS providers comprise the remaining 25 percent.
- License costs are based on the average actual bids in the recently concluded MTA license auctions.

- Valuation is based on discounted cash flow methodology, using a 12.9 percent after-tax weighted average cost of capital for the discount rate and a terminal multiple of 12 times earnings before interest, taxes, depreciation, and amortization (EBITDA).

For each MTA, the model was run at five different ARPS levels, ranging from $45 per month down to $25 per month. Market shares are presented in terms of the share of the PCS market only, not in terms of the overall wireless voice market (i.e., PCS, cellular, and ESMRS). The definition of "survival" is obtaining a net present value greater than zero. The data are summarized in the figure below.

Required Market Share for Survival as a Function of ARPS

ARPS	Large Markets	Medium Markets	Small Markets
$45	17% to 35%	16% to 31%	33% to 83%
$40	22% to 47%	22% to 42%	42% to 100%
$35	31% to 48%	34% to 66%	62% to 100%+
$30	67% to 100%+	80% to 100%+	100%+
$25	100%+	100%+	100%+

Source: EDS research

The slightly higher market share required for survival in large markets (relative to the share required for medium-sized markets) is due to the unusually high bidding amounts, and thus license costs, experienced during the PCS auctions for these markets.

Three important inferences appear to arise from this analysis. First, no PCS provider may be able to survive the Ice Age if ARPS drops to $25 per month. Second, companies in smaller markets will have a much more difficult time surviving. The minimum market share required for survival in small markets appears to be roughly double that required in medium or large markets, simply because the population of those small markets is lower than needed to support full network build-out (e.g., 66 percent population coverage). Third, reasonably aggressive market shares (e.g., 25 to 40 percent) appear adequate for survival only in medium and large markets and only when ARPS exceed $40 per month. The question remains, however, whether ARPS in excess of $40 per month is sustainable in an environment so conducive to price competition. With the majority of new customers currently averaging about $40 per month in an environment of no price competition, it seems unlikely that ARPS will stay above $40 per month.

Suppose ARPS drops to $35, a very reasonable assumption given the likelihood of price wars. The 30 to 60 percent market share required for survival in the large markets means that not all of the three to five new facilities-based providers can survive. **As some of the companies begin to realize that they face extinction, they will begin to get desperate in an attempt to gain market share. This desperation will likely manifest itself in price reductions for a relative price differential may be effective in attracting customers. The larger players may in turn**

reduce price in order to close the gap and maintain market share. This downward price spiral is very much a possibility and will merely serve to increase the required market share for survival.

It is hard to believe that the bidders in the PCS auctions for the A and B blocks are not aware of the implications of the data. The explanation for their presence at the auctions and their willingness to bid significant sums of money must relate to their optimism regarding their ability to obtain disproportionate market shares. Clearly, that optimism cannot be realistic for all potential bidders. **Since the sum of the market shares cannot exceed 100%, all claims on disproportionate share cannot be valid.**

4.2.3 Effect of Revenue Inadequacy on Existing Cellular Carriers

Cellular telephony incumbents can depend on their existing networks and customer bases to enjoy a headstart over their PCS competitors. Indeed, many industry analysts project that cellular incumbents will have a combined 60 percent market share of the overall wireless voice market in the year 2005. However, those incumbents will still fully experience Ice Age conditions of declining ARPS and eventual market saturation.

Since the industry is still relatively low in the development of demand, over the next few years cellular telephony providers will continue to grow very fast even with PCS competition. Significant subscriber growth can still be attained in an environment of falling market share.

Nothing, however, will insulate cellular telephony incumbents from the effects of the intensification of competition expressed in terms of decreasing prices and increasing customer churn. In the Ice Age, it is quite possible that the effects of the intensification of competition will be to contemplate both subscriber growth and revenue decline.

4.3 Skills

In the face of revenue inadequacy and intense competition, operational effectiveness in the Ice Age will be a critical success factor to a degree unprecedented in the Golden Age.

Effectiveness in marketing and in cost management will not only be conditions to survival, but it will also be a source of increased competitive intensity. Effective marketing by one competitor will, in light of revenue inadequacy, place significant pressure on other competitors. Their reaction will likely come in the form of price competition. Effectiveness in cost management provides scope for price flexibility which, for the same reason, will add to the competitive pressures.

Competitive skills thus not only increase the likelihood of survival on the part of on competitor, but they also increase likelihood of extinction on the part of another.

4.4 Stores of Food

The financial markets will behave less kindly towards wireless providers in the Ice Age when compared to the relative largesse of debt and equity providers in the Golden Age. Capital providers will not respond to the Ice Age conditions of competitive intensity and revenue inadequacy in the same manner they responded to the duopoly market structure and revenue adequacy of the Golden Age.

Vendor and venture capital may well be available at the early stages of the new era, but the supply of capital will soon dwindle for carriers which do not demonstrate the operational effectiveness to achieve expected results.

If vendors and venture capital suppliers believed that a Wireless Ice Age was coming, then they would likely withhold their capital, and the result would be the emergence of fewer competitors and, ironically, a more moderate Ice Age climate. The persistence of the lessons drawn from the Golden Age makes such an early withholding of capital less likely. Carriers which disappoint the suppliers of their capital will be condemned to extinction because continued investment requirements and operating losses will create a clear dependency on capital supply as revenues will not provide needed cash.

4.5 Last Word on the Challenges of the Ice Age

Each of the forces which has shaped the wireless world is about to change. Each of the changes appears to point inescapably to a far more hostile environment than the wireless world has ever known.

The hostility of the climate will be experienced in terms of an extraordinary increase in the intensity of competition for the supply of revenue/sustenance. That food supply will often be inadequate to feed the growing population, a situation exacerbated by declining stores of food. As a result, competitive skills will become increasingly important for survival. **Welcome to the Wireless Ice Age.**

> *"About half a million years ago Europe and Asia were visited by periods of intense cold – the so-called Ice Ages – that lasted thousands of years."*
>
> **V. Gordon Childe**
> ***Man Makes Himself (1951)***

> *"Population, when unchecked, increases in a geometrical ratio. Subsistence increases in an arithmetic ratio."*
>
> **Thomas Robert Malthus**
> ***Essay on the Principle of Population (1798)***

"Although some species may be now increasing, more or less rapidly, in numbers, all cannot do so, for the world would not hold them."

Charles Darwin
On the Origin of Species (1859)